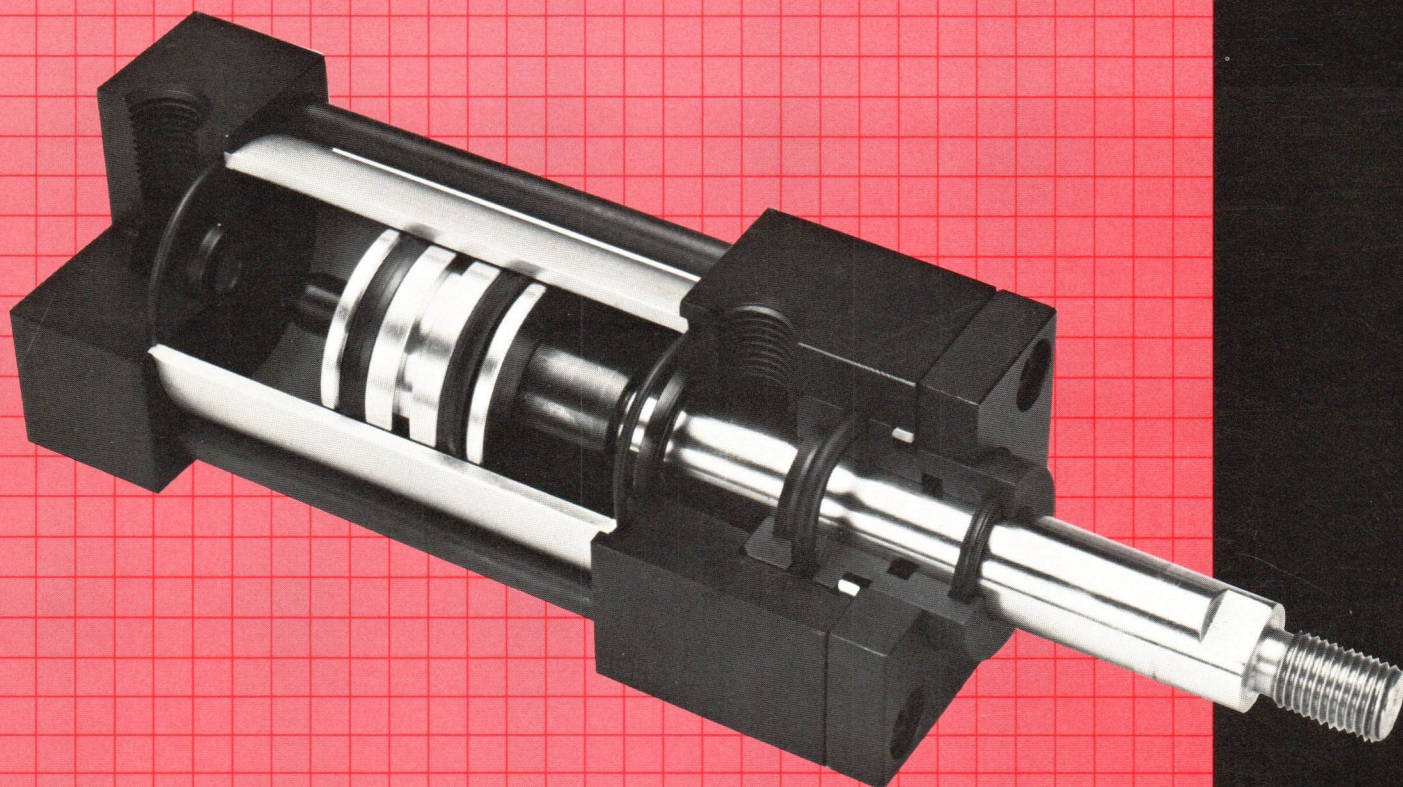


milwaukee  
*Cylinder*  
a versatek company

**SERIES V**

1½" thru 8" Bore  
250 PSI Air (All Sizes)  
350-750 PSI Oil



**AIR/HYDRAULIC  
CYLINDERS**

**with Removable Retainers**

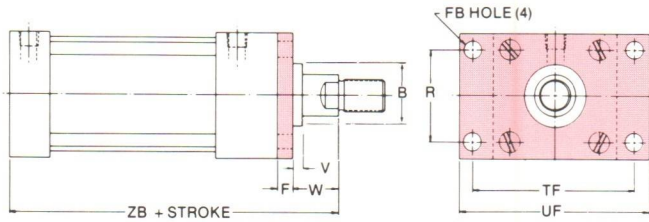


National  
**FLUID  
POWER**  
Association  
MEMBER



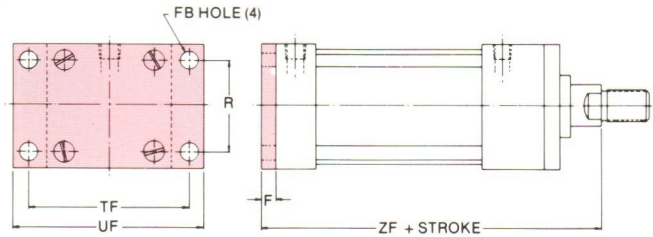
# Flange Mount

**Model V31 Front Flange Mount (NFPA MF1)**



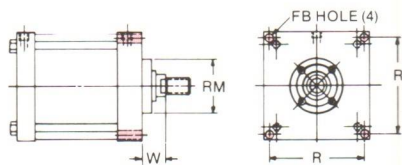
NOTE: NOT AVAILABLE IN 8" BORE SEE MODEL V21

**Model V32 Rear Flange Mount (NFPA MF2)**



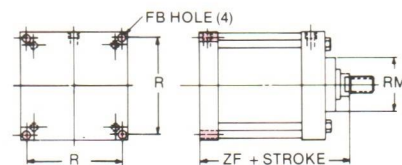
NOTE: NOT AVAILABLE IN 8" BORE SEE MODEL V22

**Model V21 Head Flange Mount (NFPA ME3)**



NOTE: AVAILABLE IN 8" BORE ONLY

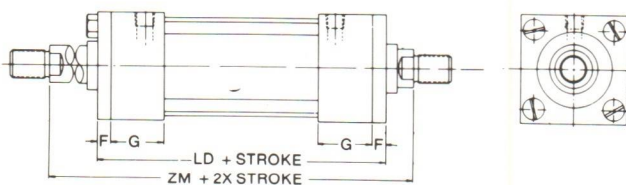
**Model V22 Cap Flange Mount (NFPA ME4)**



NOTE: AVAILABLE IN 8" BORE ONLY

Bore	ROD Diameter	B	F	FB	R	RM	TF	UF	V	W	ZB	ZF
1-1/2	5/8 Std.	1-1/8	3/8	5/16	1.43	X	2-3/4	3-3/8	1/4	5/8	4-5/8	5
	1	1-5/16							1/2	1	5	5-3/8
2	5/8 Std.	1-1/8	3/8	3/8	1.84	X	3-3/8	4-1/8	1/4	5/8	4-5/8	5
	1	1-1/2							1/2	1	5	5-3/8
2-1/2	5/8 Std.	1-1/8	3/8	3/8	2.19	X	3-7/8	4-5/8	1/4	5/8	4-3/4	5-1/8
	1	1-1/2							1/2	1	5-1/8	5-1/2
3-1/4	1 Std.	1-1/2	5/8	7/16	2.76	X	4-11/16	5-1/2	1/4	3/4	5-5/8	6-1/4
	1-3/8	2							3/8	1	5-7/8	6-1/2
4	1 Std.	1-1/2	5/8	7/16	3.32	3	5-7/16	6-1/4	1/4	3/4	5-5/8	6-1/4
	1-3/8	2				3-1/2			3/8	1	5-7/8	6-1/2
5	1 Std.	1-1/2	5/8	9/16	4.10	3	6-5/8	7-5/8	1/4	3/4	5-7/8	6-1/2
	1-3/8	2				3-1/2			3/8	1	6-1/8	6-3/4
6	1-3/8 Std.	2	3/4	9/16	4.88	3-3/8	7-5/8	8-5/8	1/4	7/8	6-5/8	7-3/8
	1-3/4	2-3/8				4-1/4			3/8	1-1/8	6-7/8	7-5/8
8	1-3/8 Std.	2	3/4	11/16	7.57	3-3/8	X	X	1/4	1-5/8	6-3/4	6-3/4
	1-3/4	2-3/8				4-1/4			3/8	1-7/8	7	7

**Model V11 Double Rod End**



Bore	F	G	LD	ZM
1-1/2	3/8	1-1/2	4-7/8	6-1/8
				6-7/8
2	3/8	1-1/2	4-7/8	6-1/8
				6-7/8
2-1/2	3/8	1-1/2	5	6-1/4
				7
3-1/4	5/8	1-3/4	6	7-1/2
				8
4	5/8	1-3/4	6	7-1/2
				8
5	5/8	1-3/4	6	7-1/2
				8
6	3/4	2	7	8-3/4
				9-1/4
8	3/4	2	7-1/8	8-7/8
				9-3/8



# Basic Dimensional Data

**Series V**  
**Pressure Ratings**  
**Standard Rods**  
**1½"-8" Bores**  
**250 psi Air**

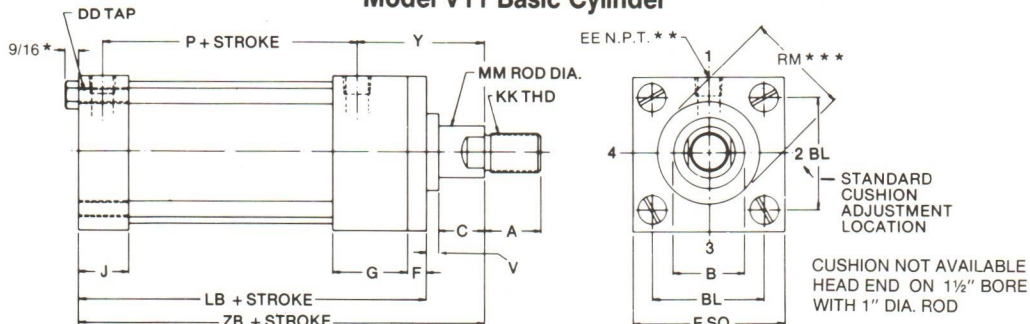
**1½"-2½" Bores**  
**750 psi Oil**

**3¼"-6" Bores**  
**500 psi Oil**

**8" Bore**  
**350 psi Oil**

**Stock Stroke**  
**Lengths: 1", 2", 3"**  
**4", 5", 6", 7"**  
**8", 9", 10", 12"**  
**14", 16", 18", 20"**  
**Other Stroke**  
**Lengths Available**  
**Upon Request**

## Model V11 Basic Cylinder



\*8" Bore only.

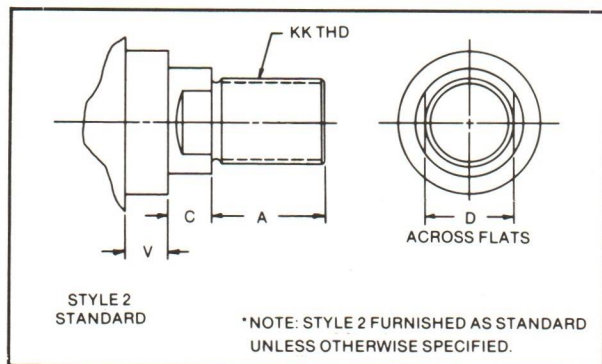
\*\*One size larger N.P.T.  
 Available upon request

\*\*\*1½" thru 3¼" Bore. Square cartridge  
 retainer plate (E dim.) 4" Bore and larger  
 Round cartridge retainer plate (RM dim.).

Bore	ROD Diameter	KK Thds.	A Length	B	BL	C	DD	E	EE**	F	G	J	LB	P	RM	V	Y	ZB
1-1/2	5/8 Std.	7/16-20	3/4	1-1/8	1.43	3/8	1/4-28	2	1/4	3/8	1-1/2	1	4	2-1/8	X	1/4	2	4-5/8
	1	3/4-16	1-1/8	1-5/16		1/2										1/2	2-3/8	5
2	5/8 Std.	7/16-20	3/4	1-1/8	1.84	3/8	5/16-24	2-1/2	1/4	3/8	1-1/2	1	4	2-1/8	X	1/4	2	4-5/8
	1	3/4-16	1-1/8	1-1/2		1/2										1/2	2-3/8	5
2-1/2	5/8 Std.	7/16-20	3/4	1-1/8	2.19	3/8	5/16-24	3	1/4	3/8	1-1/2	1	4-1/8	2-1/4	X	1/4	2	4-3/4
	1	3/4-16	1-1/8	1-1/2		1/2										1/2	2-3/8	5-1/8
3-1/4	1 Std.	3/4-16	1-1/8	1-1/2	2.78	1/2	3/8-24	3-3/4	3/8	5/8	1-3/4	1-1/4	4-7/8	2-5/8	X	1/4	2-7/16	5-5/8
	1-3/8	1-14	1-5/8	2		5/8										3/8	2-11/16	5-7/8
4	1 Std.	3/4-16	1-1/8	1-1/2	3.32	1/2	3/8-24	4-1/2	3/8	5/8	1-3/4	1-1/4	4-7/8	2-5/8		3	1/4	2-7/16
	1-3/8	1-14	1-5/8	2		5/8										3-1/2	3/8	2-11/16
5	1 Std.	3/4-16	1-1/8	1-1/2	4.12	1/2	1/2-20	5-1/2	3/8	5/8	1-3/4	1-1/2	5-1/8	2-7/8		3	1/4	2-7/16
	1-3/8	1-14	1-5/8	2		5/8										3-1/2	3/8	2-11/16
6	1-3/8 Std.	1-14	1-5/8	2	4.88	5/8	1/2-20	6-1/2	1/2	5/8	2	1-1/2	5-3/4	3-1/8		3-3/8	1/4	2-13/16
	1-3/4	1-1/4-12	2	2-3/8		3/4										4-1/4	3/8	3-1/16
8	1-3/8 Std.	1-14	1-5/8	2	6.44	5/8	5/8-18	8-1/2	1/2	5/8	2	1-1/2	5-7/8	3-1/4		3-3/8	1/4	2-13/16
	1-3/4	1-1/4-12	2	2-3/8		3/4										4-1/4	3/8	3-1/16

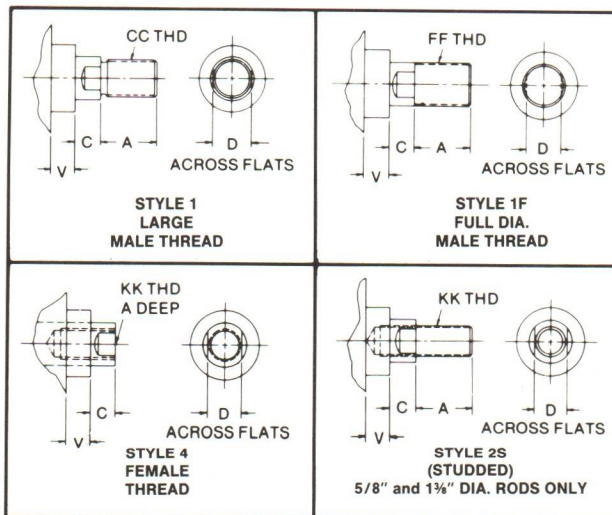
## Rod end styles

### Standard



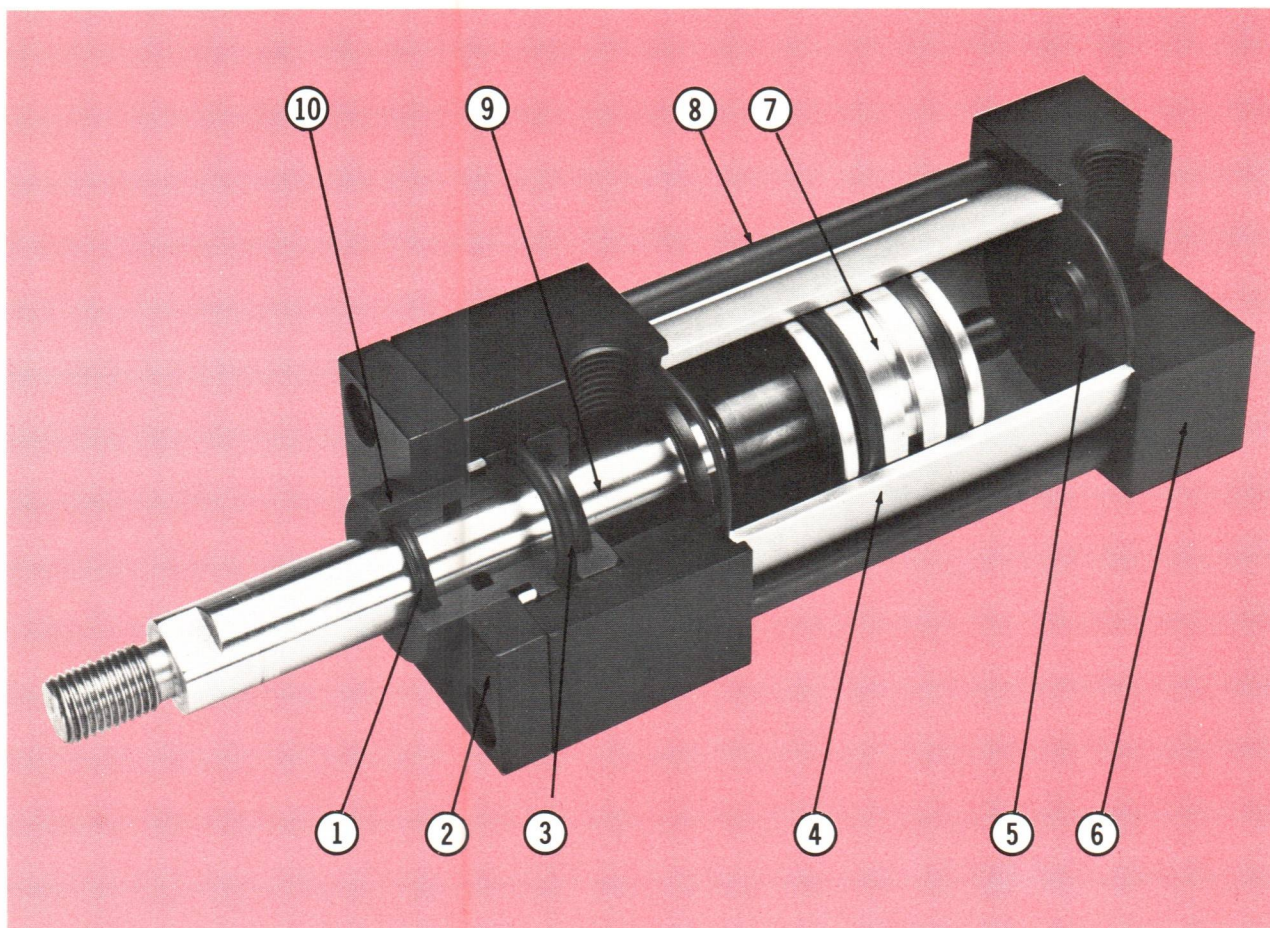
ROD DIA.	A	C	D	CC	FF	KK
5/8	3/4	3/8	1/2	1/2-20	5/8-14	7/16-20
1	1-1/8	1/2	7/8	7/8-14	1-14	3/4-16
1-3/8	1-5/8	5/8	1-3/16	1-1/4-12	1-3/8-12	1-14
1-3/4	2	3/4	1-1/2	1-1/2-12	1-3/4-12	1-1/4-12

### Optional





# Standard Features



## Advantages of the Milwaukee Cylinder Design

Milwaukee Cylinder is a leader in the design and construction of aluminum NFPA cylinders and we offer many unique design advantages. The major ones are described and illustrated here.

The single most important advantage of an aluminum cylinder is usually considered to be weight. But there's an equally important one. Cost. Lighter Milwaukee Cylinder cylinders often cost up to 50% less than their heavier steel counterparts.

In addition to weight, cost and design advantages, at Milwaukee Cylinder you can benefit from our total cylinder system concept. We don't just provide cylinders. First, you choose the basic cylinder you need. Then we customize it with options and accessories. The result is that you get a total, economical cylinder system.

Milwaukee Cylinder pneumatic and hydraulic cylinders are NFPA interchangeable and available in eight bore sizes. All are permanently lubricated, and you can choose from 15 stock stroke lengths and 11 mounting styles.

## Standard Features

### 1. Rod Wiper

The rod wiper\* is a quad-ring dual lip design that keeps pressure and fluids in while sealing dirt, dust and other contaminants out. The wiper also serves as a secondary rod seal.

### 2. Removable Retainer Plate

The retainer plate and rod bushing are externally removable. On most models total disassembly of the cylinder is not necessary. Four self-locking capscrews hold the retainer plate in place.

### 3. Rod Seals

Pressure energized and wear-compensating lip-type rod seals\* offer low friction and long life.

### 4. Cylinder Barrel

Aluminum alloy barrel with a "file hard" inner diameter provides an excellent wear surface and resistance to corrosion.

### 5. End Seals

"O" ring tube end seals\* provide positive sealing well beyond rated pressures.

### 6. End Caps

The head and cap are precision machined from solid, high-strength aluminum alloy bar stock. They are durable and non-porous to prevent cracking and porosity leaks.

### 7. Piston

Solid aluminum alloy piston offers long bearing support. Its light weight helps reduce kinetic load, and a built-in "lube groove" provides permanent lubrication.

### 8. Tie Rods

Prestressed steel tie rods eliminate fatigue failures and provide maximum holding power.

### 9. Piston Rod

High strength steel (100,000 psi minimum yield) piston rod has a ground, polished and hard-chrome plated surface for strong scratch resistance and longer seal life. (Optional stainless steel also available.)

### 10. Rod Bearings

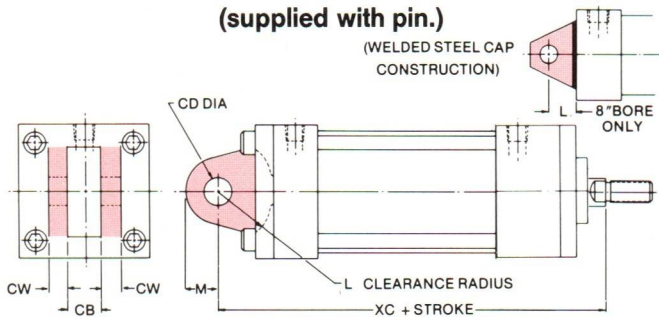
One of the longest high-density iron rod bearings in the industry provides maximum bearing support even in the toughest applications. The bearing has a built-in "lube groove" to provide permanent lubrication.

\*Standard seals are Buna "N" Compound (-40° to +200°F/Std. mineral base oil). Optional Viton seals are available for high temperature applications (up to 400°F) or for use with fire-resistant fluids.

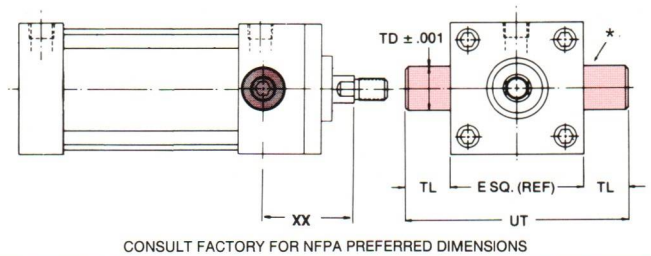


# Pin And Trunnion Mount

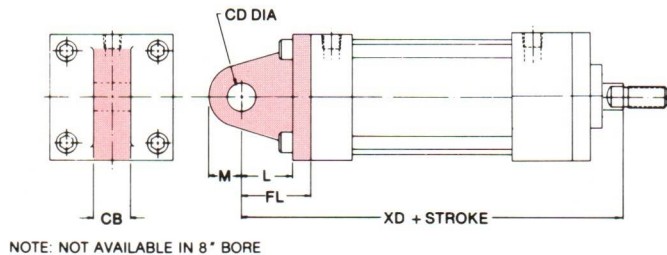
**Model V61 Clevis Mount (NFPA MP1)  
(supplied with pin.)**



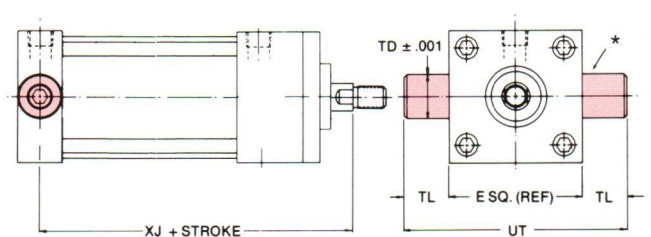
**Model V71 Rod Trunnion Mount (NFPA MT1)**



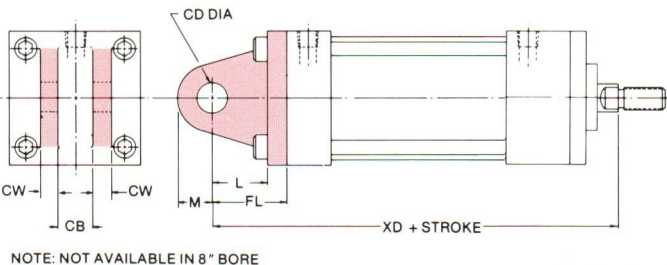
**Model V62 Detachable Eye Mount (NFPA MP4)  
(supplied with pin.)**



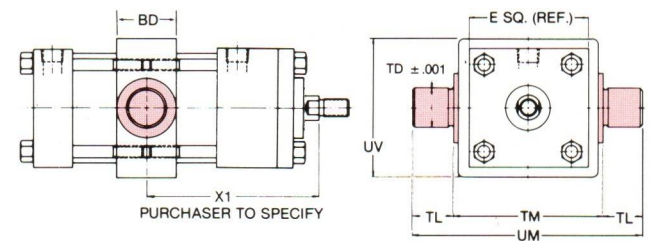
**Model V72 Blind Trunnion Mount (NFPA MT2)**



**Model V63 Detachable Clevis Mount (NFPA MP2)  
(supplied with pin.)**



**Model V73 Center Trunnion Mount (NFPA MT4)**



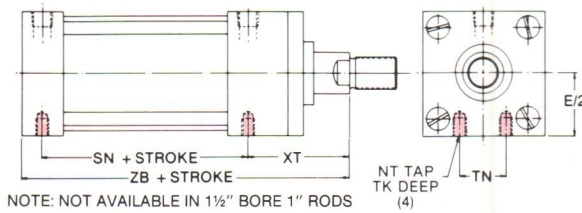
STD. NFPA CLEVIS (MPI & MP4 & MP2)											TRUNNION MT1 & MT2						MT4			
BORE	ROD Diameter	"KK" Thds.	CB	CD	CW	FL	L	M	XC	XD	E	TD	TL	UT	XX	XJ	BD	TM	UM	UV
1-1/2	5/8 Std.	7/16-20	3/4	1/2	3/8	1-1/8	3/4	5/8	5-3/8	5-3/4	2	1	1	4	1-15/16	4-1/8	1-1/4	2-1/2	4-1/2	2-1/2
	1	3/4-16							5-3/4	6-1/8		X	X	X	X	4-1/2				
2	5/8 Std.	7/16-20	3/4	1/2	1/2	1-1/8	3/4	5/8	5-3/8	5-3/4	2-1/2	1	1	4-1/2	1-15/16	4-1/8	1-1/2	3	5	3
	1	3/4-16							5-3/4	6-1/8		X	X	X	X	4-1/2				
2-1/2	5/8 Std.	7/16-20	3/4	1/2	1/2	1-1/8	3/4	5/8	5-1/2	5-7/8	3	1	1	5	1-15/16	4-1/4	1-1/2	3-1/2	5-1/2	3-1/2
	1	3/4-16							5-7/8	6-1/4		X	X	X	X	4-5/8				
3-1/4	1 Std.	3/4-16	1-1/4	3/4	3/4	1-7/8	1-1/4	7/8	6-7/8	7-1/2	3-3/4	1	1	5-3/4	2-7/16	5	2	4-1/2	6-1/2	4-1/4
	1-3/8	1-14							7-1/8	7-3/4					2-11/16	5-1/4				
4	1 Std.	3/4-16	1-1/4	3/4	3/4	1-7/8	1-1/4	7/8	6-7/8	7-1/2	4-1/2	1	1	6-1/2	2-7/16	5	2	5-1/4	7-1/4	5
	1-3/8	1-14							7-1/8	7-3/4					2-11/16	5-1/4				
5	1 Std.	3/4-16	1-1/4	3/4	3/4	1-7/8	1-1/4	7/8	7-1/8	7-3/4	5-1/2	1	1	7-1/2	2-7/16	5-1/4	2	6-1/4	8-1/4	6
	1-3/8	1-14							7-3/8	8					2-11/16	5-1/2				
6	1-3/8 Std.	1-14	1-1/2	1	1	2-1/4	1-1/2	1-1/8	8-1/8	8-7/8	6-1/2	1-3/8	1-3/8	9-1/4	2-13/16	5-7/8	2-1/2	7-5/8	10-3/8	7
	1-3/4	1-1/4-12							8-3/8	9-1/8					3-1/16	6-1/8				
8	1-3/8 Std.	1-14	1-1/2	1	3/4	X	1-1/2	1	8-1/4	X	8-1/2	1-3/8	1-3/8	11-1/4	2-13/16	6	X	X	X	X
	1-3/4	1-1/4-12							8-1/2						3-1/16	6-1/4				

\*Hard chrome plated steel trunnion pins; pressure rating 125 psi for V71 and V72.

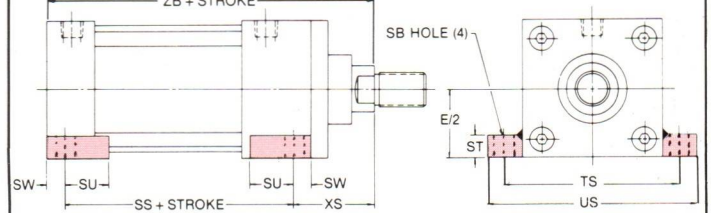


# Side and Lug Mount

**Model V41 Bottom Tap Mount (NFPA MS4)**



**Model V42 Lug Mount (NFPA MS2)**

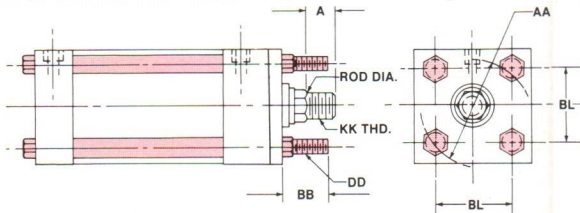


**BOTTOM TAP MOUNT (NFPA MS4)**

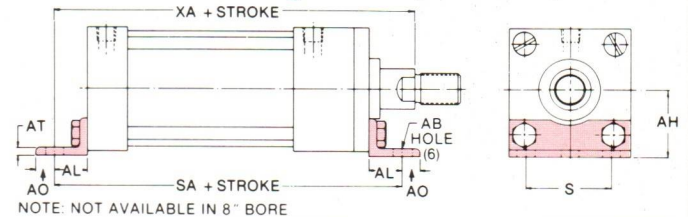
BORE	ROD Diameter	NT	TK	TN	SN	XT	ZB	E/2	SB	SS	ST	SU	SW	TS	US	ZB	XS
1-1/2	5/8 Std.	1/4-20	3/8	5/8	2-1/4	1-15/16	4-5/8	1	13/32	2-7/8	1/2	15/16	3/8	2-3/4	3-1/2	4-5/8	1-3/8
	1	X	X	X	X	X	X									5	1-3/4
2	5/8 Std.	5/16-18	1/2	7/8	2-1/4	1-15/16	4-5/8	1-1/4	13/32	2-7/8	1/2	15/16	3/8	3-1/4	4	4-5/8	1-3/8
	1					2-5/16	5									5	1-3/4
2-1/2	5/8 Std.	3/8-16	5/8	1-1/4	2-3/8	1-15/16	4-3/4	1-1/2	13/32	3	1/2	15/16	3/8	3-3/4	4-1/2	4-3/4	1-3/8
	1					2-5/16	5-1/8									5-1/8	1-3/4
3-1/4	1 Std.	1/2-13	3/4	1-1/2	2-5/8	2-7/16	5-5/8	1-7/8	17/32	3-1/4	3/4	1-1/4	1/2	4-3/4	5-3/4	5-5/8	1-7/8
	1-3/8					2-11/16	5-7/8									5-7/8	2-1/8
4	1 Std.	1/2-13	3/4	2-1/16	2-5/8	2-7/16	5-5/8	2-1/4	17/32	3-1/4	3/4	1-1/4	1/2	5-1/2	6-1/2	5-5/8	1-7/8
	1-3/8					2-11/16	5-7/8									5-7/8	2-1/8
5	1 Std.	5/8-11	1	2-11/16	2-7/8	2-7/16	5-7/8	2-3/4	25/32	3-1/8	1	1-9/16	11/16	6-7/8	8-1/4	5-7/8	2-1/16
	1-3/8					2-11/16	6-1/8									6-1/8	2-5/16
6	1-3/8 Std.	3/4-10	1-1/8	3-1/4	3-1/8	2-13/16	6-5/8	3-1/4	25/32	3-5/8	1	1-9/16	11/16	7-7/8	9-1/4	6-5/8	2-5/16
	1-3/4					3-1/16	6-7/8									6-7/8	2-9/16
8	1-3/8 Std.	3/4-10	1-1/8	4-1/2	3-1/4	2-13/16	6-3/4	4-1/4	25/32	3-3/4	1	1-9/16	11/16	9-7/8	11-1/4	6-3/4	2-5/16
	1-3/4					3-1/16	7									7	2-9/16

**WELDED LUG MOUNT (NFPA MS2)**

**Model V12 Tie Rods Extend Rod End (NFPA MX3)**



**Model V44 Angle Mount (NFPA MS1)**



**BASIC INFORMATION**

**TIE ROD MOUNTS**

**ANGLE MOUNT (NFPA MS1)**

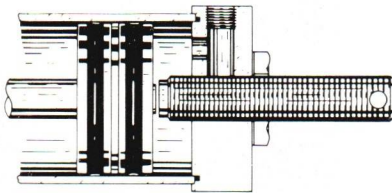
BORE	ROD Diameter	"KK" Thds.	"A"	AA	BB	BL	DD	AB	AH	AL	AD	AT	S	SA	XA
1-1/2	5/8 Std.	7/16-20	3/4	2.02	1	1.43	1/4-28	7/16	1-3/16	1	3/8	1/8	1-1/4	6	5-5/8
	1	3/4-16	1-1/8												6
2	5/8 Std.	7/16-20	3/4	2.60	1-1/8	1.84	5/16-24	7/16	1-7/16	1	3/8	1/8	1-3/4	6	5-5/8
	1	3/4-16	1-1/8												6
2-1/2	5/8 Std.	7/16-20	3/4	3.10	1-1/8	2.19	5/16-24	7/16	1-5/8	1	3/8	1/8	2-1/4	6-1/8	5-3/4
	1	3/4-16	1-1/8												6-1/8
3-1/4	1 Std.	3/4-16	1-1/8	3.90	1-3/8	2.78	3/8-24	9/16	1-15/16	1-1/4	1/2	3/16	2-3/4	7-3/8	6-7/8
	1-3/8	1-14	1-5/8												7-1/8
4	1 Std.	3/4-16	1-1/8	4.70	1-3/8	3.32	3/8-24	9/16	2-1/4	1-1/4	1/2	3/16	3-1/2	7-3/8	6-7/8
	1-3/8	1-14	1-5/8												7-1/8
5	1 Std.	3/4-16	1-1/8	5.80	1-13/16	4.12	1/2-20	11/16	2-3/4	1-3/8	5/8	3/16	4-1/4	7-7/8	7-1/4
	1-3/8	1-14	1-5/8												7-1/2
6	1-3/8 Std.	1-14	1-5/8	6.90	1-13/16	4.88	1/2-20	13/16	3-1/4	1-3/8	5/8	1/4	5-1/4	8-1/2	8
	1-3/4	1-1/4-12	2												8-1/4
8	1-3/8 Std.	1-14	1-5/8	9.10	2-5/16	6.44	5/8-18	X	X	X	X	X	X	X	X
	1-3/4	1-1/4-12	2												X



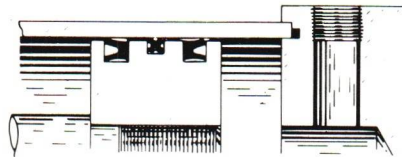
# Design options

## Cylinder options

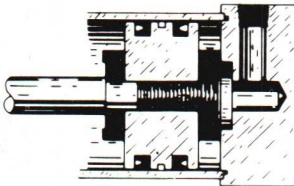
The options with which we can customize your cylinders range from noise-dampening bumpers to a full line of magnetic limit switches. By adding only the options you need, you pay only for what it takes to meet your specific requirements. A few of the available options are shown here. For more information on these and others, contact us.



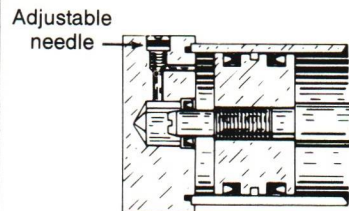
**Adjustable stroke**  
Meets varying stroke requirements.



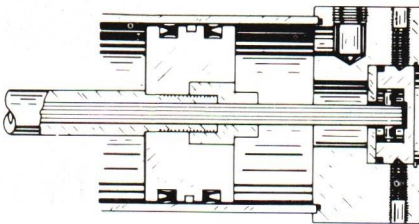
**Air/oil piston**  
Eliminates weepage past seals in air/oil systems by utilizing a "quad-ring" seal between the standard piston seals.



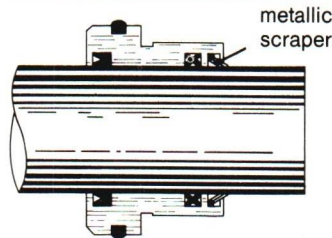
**Noise dampening pads (bumpers)**  
Permits higher piston velocities for shorter cycle time and reduces noise level for quiet operation.



**Cushions** Resilient lip type "cushion seal" is a seal and "check" in one. Self-centering and pressure loaded for positive cushion action.



**Non-rotating rod**  
For "pick and place" and similar applications.



**Metallic rod scraper**  
For harsh environments. An added "quad-ring" wiper prevents contamination from entering through bushing.

## Weight chart - basic cylinders

BORE	MODEL								ADD PER IN. OF STROKE
	V11	V44/V71 V72	V41	V61*	V63*	V62*	V31/V32	V42	
1½	1.6	2.0	1.6	2.1	2.2	2.2	2.2	2.5	.20
2	2.4	2.9	2.4	3.2	3.3	3.2	3.4	3.6	.25
2½	3.3	3.9	3.3	4.3	4.5	4.5	4.6	4.7	.27
3¼	6.5	7.9	6.5	9.2	10.1	10.0	9.8	9.0	.51
4	8.8	10.5	8.8	12.1	13.3	13.2	13.3	11.1	.55
5	13.2	14.3	13.2	17.8	19.9	19.0	20.0	17.5	.59
6	21.5	25.2	21.5	29.7	32.2	32.2	32.2	27.2	.84
8	35.4	36.5	35.4	43.5	N/A	N/A	35.4	44.9	1.25

All weights are in pounds. For oversize rod add 10%

\*Weight includes clevis pins



## Limit switches - up to 3 amp capability

Milwaukee Cylinder magnetically operated limit switches consist of a single pole, single throw, normally open switch hermetically sealed in a glass tube. All electrical components are fully epoxy encapsulated.

The switch is designed to close in the presence of a magnetic field, produced by a permanent magnet built into the piston of the cylinder. Properly applied, this superior limit switch offers substantial advantages and overall system cost savings over conventional mechanical limit switch installations.

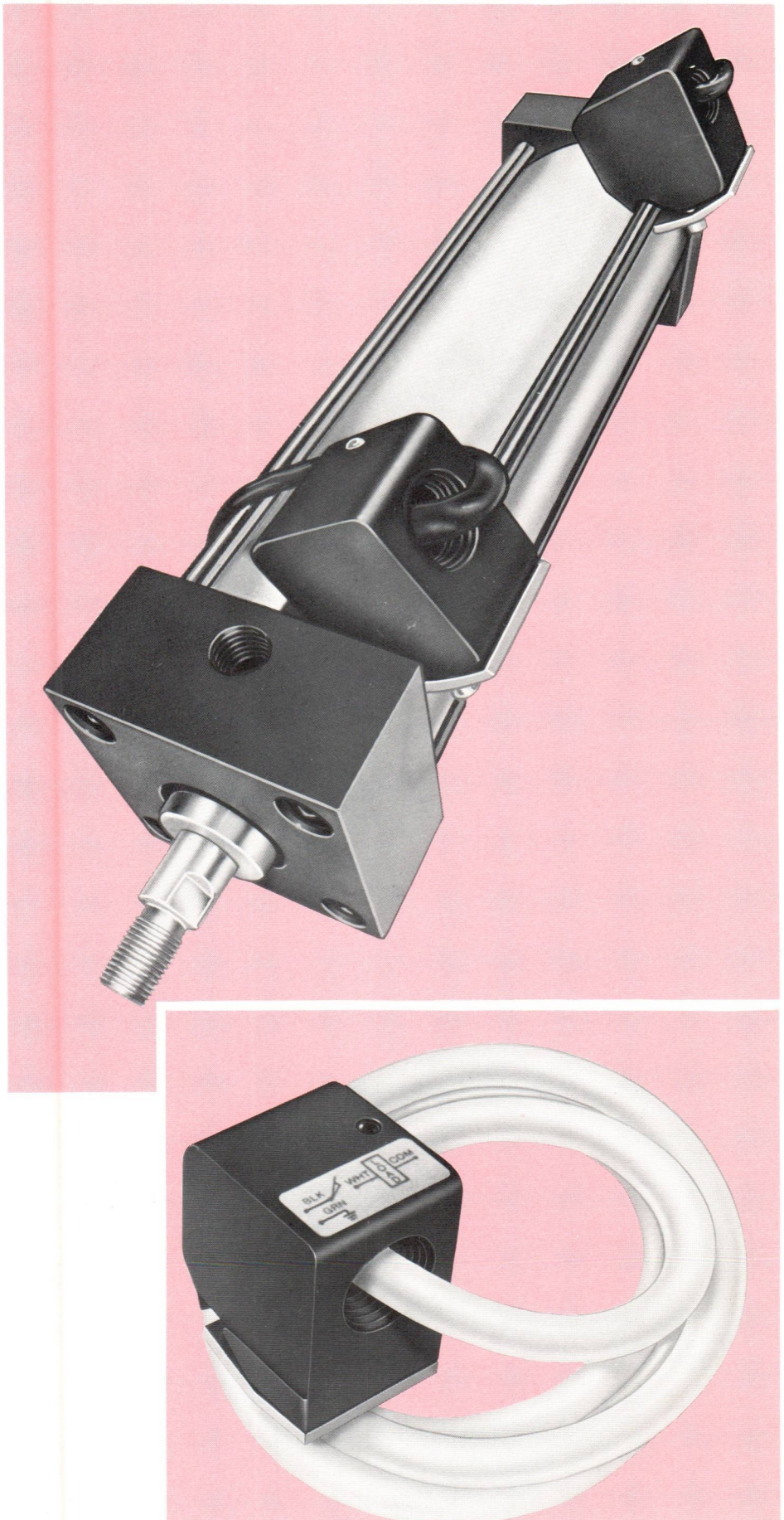
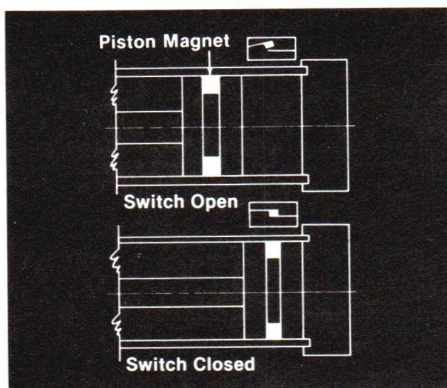
These new limit switches may be applied to any Milwaukee Cylinder Series "V" cylinders equipped with an LS magnetic piston.

Since the switches are adjustable on the tie rods, signals anywhere within the cylinder stroke are possible. Select a mid-stroke or end-of-stroke\* position, or use multiple switches for sequencing. To make installation and troubleshooting simpler, all switches come complete with an LED light that indicates when the switch is closed.

The switches are available in two different power levels: Model L10 low-level 10 watt, 0.5 amp. maximum for signaling electronic circuits with resistive loads only; Model H360 high-level 360VA 3.0 amp. with built-in triac and transient protection for use with electro-mechanical components or relays (inductive loads). In most instances, use of the H360 switch eliminates the need for a relay.

\*Note: End-of-stroke signals will occur approximately 3/8" from full stroke.

### Switch Operation





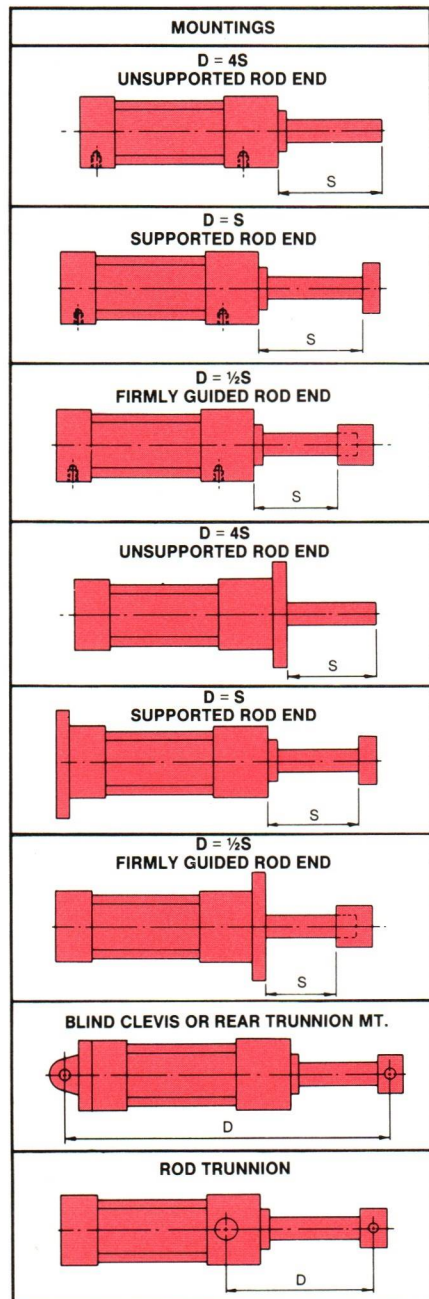
# Engineering data - rod and stop tube selection

## Rod size selection

To determine the minimum recommended piston rod diameter for your application, first determine the cylinder thrust using the force volume chart. (Thrust equals bore area multiplied by the operating pressure.)

Next, select from the diagrams below the type of mounting you'll use. Then determine the length of "D" with the piston rod in the fully extended position.

Finally, find the value of "D" at the bottom of the selector chart. Follow its line upward until it intersects with the horizontal line representing the thrust. The stripe within which these lines intersect represents the minimum recommended piston rod diameter.



ALL PISTON RODS SHOWN IN EXTENDED POSITION.

## Force volume chart

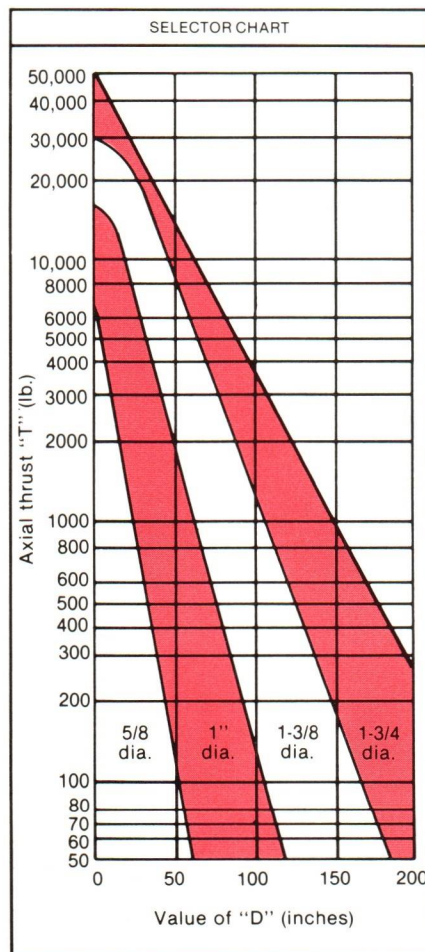
### Push Forces

BORE	PISTON AREA	PSI										ROD DISPLACEMENT*
		40	50	60	80	100	125	150	175	200	250	
1½	1.77	71	88	106	142	177	221	266	310	353	442	.00102
2	3.14	126	157	189	251	314	392	471	549	628	785	.00182
2½	4.91	196	246	295	393	491	614	737	859	982	1227	.00284
3¼	8.30	322	415	498	664	830	1037	1245	1452	1659	2075	.00480
4	12.57	503	629	754	1005	1257	1571	1886	2200	2513	3142	.00727
5	19.64	785	982	1178	1571	1964	2455	2946	3437	3928	4910	.01137
6	28.27	1131	1414	1696	2262	2827	3534	4241	4947	5654	7068	.01636
8	50.27	2011	2514	3016	4022	5027	6284	7541	8797	10054	12567	.02909

### Deduct these forces for pull strokes

ROD DIA.	ROD AREA	PSI										ROD DISPLACEMENT*
		40	50	60	80	100	125	150	175	200	250	
5/8	.307	12	15	18	25	31	38	46	54	61	77	.00018
1	.785	31	39	47	63	79	98	118	137	157	196	.00045
1⅜	1.485	59	74	89	119	149	186	223	260	297	371	.00086
1¾	2.405	96	120	144	192	241	301	361	421	481	601	.00139

\*cubic-feet / inch of stroke

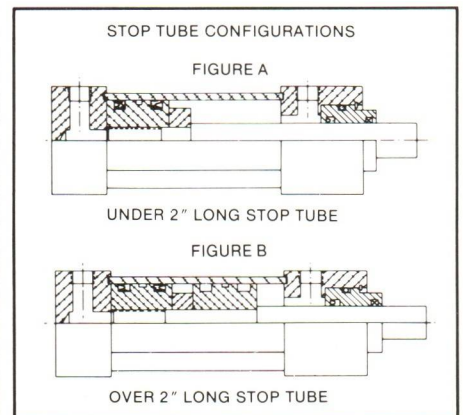


## Stop tube selection

Stop tubes are installed between the piston and the head on long stroke cylinders to reduce the load on the bearing. That, in turn, reduces bearing wear and tendency to buckle.

To determine if a stop tube is required and, if so, its length, first determine the value of "D" from the diagrams at left. If "D" is less than 40", no stop tube is needed. If "D" is over 40", a one-inch stop tube is recommended for every 10" (or fraction thereof) over 40".

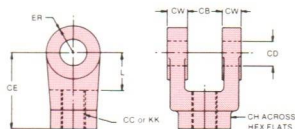
Milwaukee Cylinder supplies two types of stop tubes for air cylinders. A cylinder with over two inches of stop tube, cushioned or non-cushioned, utilizes dual piston construction for added bearing surface as well as increasing distance between bearings (figure B). A cylinder requiring a stop tube under two inches uses a spacer only (figure A).





# NFPA accessories

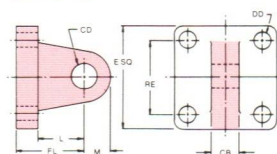
## NFPA rod clevis



PART #	CB	CC	CD	CE	CH	CW	ER	KK	L
V-92-03	3/4	1/2-20	1/2	1 1/2	1	1/2	1/2	—	3/4
V-92-03A	3/4	—	1/2	1 1/2	1	1/2	1/2	7/16-20	3/4
V-92-065	1 1/4	—	3/4	2 3/4	1 1/4	3/4	3/4	3/4-16	1 1/4
V-92-12	1 1/2	—	1	3 1/4	1 1/2	3/4	1	1-14	1 1/2
*V-92-12A	1 1/2	—	1	3 1/4	1 1/2	3/4	1	1 1/4-12	1 1/2

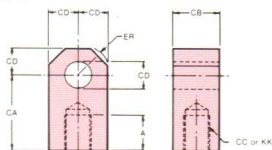
\*Non NFPA

## NFPA eye bracket



PART #	CB	CD	DD	E	FL	L	M	RE	USED ON BORES
V-89-03	3/4	1/2	13/32	2 1/2	1 1/8	3/4	1/2	1.62	1 1/2-2 1/2"
V-89-065	1 1/4	3/4	17/32	3 3/4	1 1/8	1 1/4	3/4	2.56	3 1/4-4 1/2"
V-89-12	1 1/2	1	21/32	4 1/2	2 1/4	1 1/2	1	3.25	6-8"

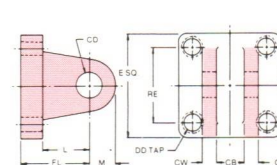
## NFPA rod eye



PART #	A	CA	CB	CC	CD	ER	KK
V-97-03	3/4	1 1/2	3/4	1/2-20	1/2	9/16	—
V-97-03A	3/4	1 1/2	3/4	—	1/2	9/16	7/16-20
V-97-065	1 1/4	2-1 1/16	1 1/4	—	3/4	15/16	3/4-16
V-97-12	1 1/2	2-13/16	1 1/2	—	1	1 1/8	1-14
*V-97-12A	2	2-13/16	1 1/2	—	1	1 1/8	1 1/4-12

\*Non NFPA

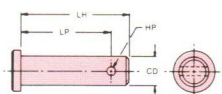
## NFPA clevis bracket



PART #	CB	CD	CW	DD	E	FL	L	M	RE	USED ON BORES
V-91-03	3/4	1/2	1/2	3/8-24	2 1/2	1 1/8	3/4	1/2	1.62	1 1/2-2 1/2"
V-91-065	1 1/4	3/4	3/8	1/2-20	3 1/2	1 1/8	1 1/4	3/4	2.56	3 1/4-4 1/2"
V-91-12	1 1/2	1	3/4	3/8-18	4 1/2	2 1/4	1 1/2	1	3.25	6-8"

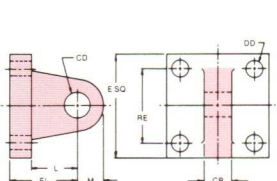
# Other accessories

## Clevis pins



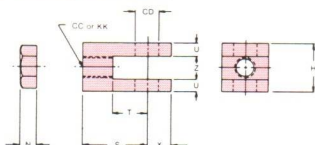
PART #	CD	HP	LH	LP	USED ON
V-96-03	1/2	5/32	2 1/4	2-3/32	1 1/2-2 1/4" bore, V-92-03&A Clevis & eye mt.
V-96-03A	1/2	5/32	1 3/4	1-19/32	V-93-03 & A / V-97-03 & A / V-99-03A
V-96-065	3/4	5/32	3 1/4	3-3/64	3 1/4-4 1/2" bore Clevis & eye mt.
V-96-065A	3/4	5/32	2 3/4	2-19/32	V-92-065 / V-93-065 / V-97-065 / V-99-065
V-96-12	1	13/64	4	3-13/16	6" & 8" bore Clevis & eye mt.
V-96-12A	1	13/64	3 1/2	3-5/16	V-92-12&A / V-97-12&A / V-99-12

## Eye bracket



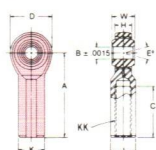
PART #	CB	CD	DD	E	FL	L	M	RE
V2-89-03	3/4	1/2	9/32	2	1 1/8	3/4	5/8	1.43
V2-89-04	3/4	1/2	11/32	2 1/2	1 1/8	3/4	5/8	1.84
V2-8905	3/4	1/2	11/32	3	1 1/8	3/4	5/8	2.19
V2-89-065	1 1/4	3/4	13/32	3 3/4	1 1/8	1 1/4	7/8	2.78
V2-89-08	1 1/4	3/4	13/32	4 1/2	1 1/8	1 1/4	7/8	3.32
V2-89-10	1 1/4	3/4	17/32	5 1/2	1 1/8	1 1/4	7/8	4.12
V2-89-12	1 1/2	1	17/32	6 1/2	2 1/4	1 1/2	1 1/8	4.88

## Rod clevis and jam nut



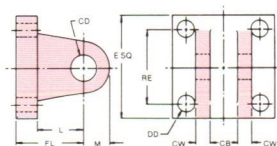
PART #	CC	CD	H	KK	N	S	T	U	X	Z
V-93-03	1/2-20	1/2	1	—	3/8	1 3/8	3/4	1/4	1/2	1/2
V-93-03A	—	1/2	1	7/16-20	3/8	1 3/8	3/4	1/4	1/2	1/2
V-93-065	—	3/4	1 1/2	3/4-16	1/2	1 3/4	1	3/8	3/4	3/4

## Spherical rod eye



PART #	A	B	C	D	E	H	J	K	KK	W
V-99-03A	2 1/2	.500	1-3/16	1-5/16	12°	1/2	3/4	3/8	7/16-20	3/8
V-99-065	2 1/2	.750	1 1/4	1 1/4	14°	11/16	1	1 1/8	3/4-16	7/8
V-99-12	4 1/8	1.000	2 1/2	2 1/4	14°	1 1/2	1 1/2	1 1/2	1"-14	1 1/2

## Clevis bracket



PART #	CB	CD	CW	DD	E	FL	L	M	RE
V2-91-03	3/4	1/2	3/8	9/32	2	1 1/8	3/4	5/8	1.43
V2-91-04	3/4	1/2	1/2	11/32	2 1/2	1 1/8	3/4	5/8	1.84
V2-91-05	3/4	1/2	1/2	11/32	3	1 1/8	3/4	5/8	2.19
V2-91-065	1 1/4	3/4	3/4	13/32	3 3/4	1 1/8	1 1/4	7/8	2.78
V2-91-08	1 1/4	3/4	3/4	13/32	4 1/2	1 1/8	1 1/4	7/8	3.32
V2-91-10	1 1/4	3/4	3/4	17/32	5 1/2	1 1/8	1 1/4	7/8	4.12
V2-91-12	1 1/2	1	1	17/32	6 1/2	2 1/4	1 1/2	1 1/8	4.88



# Limit switches - continued

## Application recommendations and precautions

These switches have been carefully engineered and tested, but since they may be installed in virtually an unlimited number of applications under a great variety of plant conditions, they should be installed as outlined below to provide maximum reliability.

1. Always stay within the specifications and power rating limitations of the unit installed.
2. Primary and control circuit wiring should not be mixed in the same conduit. Motors will produce high pulses that will be introduced into the control wiring if the wiring is carried in the same conduit.
3. Never connect the switch without a load present. The switch will be destroyed.
4. Some electrical loads may be capacitive. Capacitive loading may also occur due to distributed capacity in cable runs over 25 feet. Use switch Model H360 whenever capacitive loading may occur.

In order to obtain optimum performance and long life, magnetically operated limit switches

should not be subjected to (1) strong magnetic fields, (2) extreme temperature ranges, and (3) excessive ferrous filing or chip buildup.

Improper wiring may damage or destroy the switch. Therefore, the wiring diagram, along with the listed power ratings, should be carefully observed before connecting power to the switch.

The green ground wire should be grounded on all AC installations. The LED light will not operate unless the switch is grounded, nor will it operate on DC. Optional battery-operated tester is available upon request.

### Additional switch selection information

Lower power L10 switches are designed for signaling electronic circuits. Do not use on relay loads or with incandescent bulbs. Resistive loads only.

High power H360 switches are designed for higher resistive or inductive loads, electro-mechanical components, relays, etc.

## Specifications

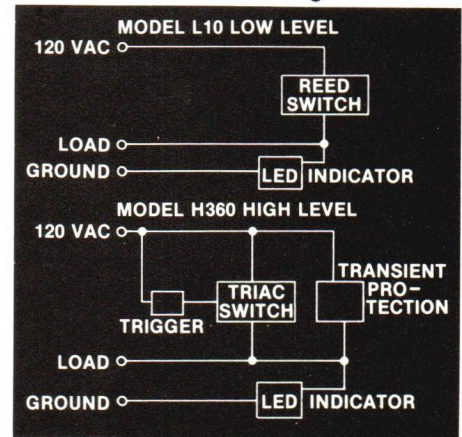
Switch Rating Model L10 (Low-Level — Reed only)	
Circuit	S.P.S.T., N.O.
Operating Voltage	0-120 Volts AC-DC
Maximum Load (Power Rating)	10 Watts, Resistive Only
Maximum Current	0.5 Amps., Maximum
Response Time — On	0.75 Milliseconds
Response Time — Off	0.05 Milliseconds
Temperature Range	- 20 to + 140°F
Caution: Switched voltage x switched current in amperes must not exceed power rating—do not use on relay loads.	
Switch Rating Model H360 (High-level — With Triac)	
Circuit	S.P.S.T., N.O.
Operating Voltage	24-120 VAC, 50/60 H
Maximum Load (Power Rating)	360 VA — Break (inductive or resistive)
Maximum Current	3.0 Amps.
Response Time — On	1.0 Millisecond
Response Time — Off	0.8 Milliseconds
Temperature Range	- 40 to + 150°F
Leakage	1.7 MA Maximum
Caution: Switched voltage x switch current in amperes must not exceed power rating.	
Both Models	
Leads	#18-3 SJTO Cable 4' long
LED Light*	Ground wire must be grounded
Case material	Aluminum
Shock	50 G's at 10 milliseconds
Vibration	20 G's from 10 to 2000 Hz
Repeatability	± .005" at constant piston speed

The electrical components are fully epoxy encapsulated in the switch case.

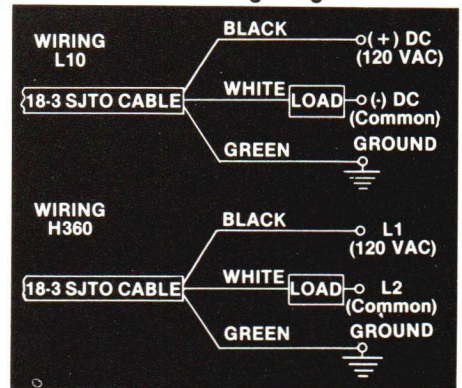
\*Note: Switch LED light does not function on DC loads.

Note: Above switches meet Nema 1, 4 and 13 specifications.

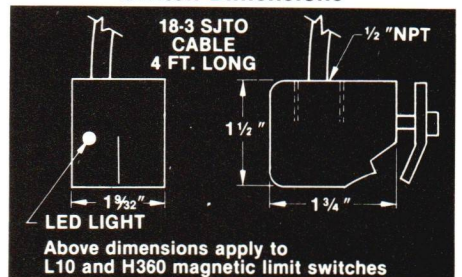
## Switch Block Diagram



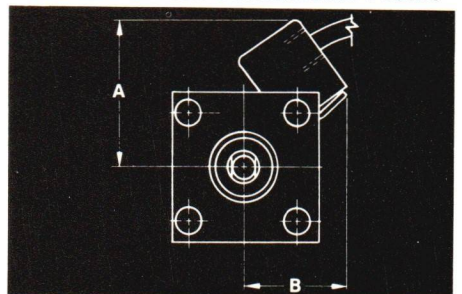
## Switch Wiring Diagram



## Switch Dimensions



## Mounted Switch Dimensional Profile



BORE	A	B
1 1/2	2.56	1.86
2	2.78	2.00
2 1/2	3.00	2.19
3 1/4	3.38	2.34
4	3.65	2.59
5	4.00	2.94
6	4.39	3.28
8	5.22	4.00



# Warranty

Seller warrants the goods sold hereunder to be free from defects in material and workmanship for a period of twelve months after date of shipment from Seller's plant. If the goods are in accordance with or in reference to an engineering drawing specified by or furnished to the customer, the specifications and information on the drawing shall be applicable in determining such correct use, operation and application.

When claiming a breach of the above warranty, Buyers must notify Sellers promptly in writing whereupon Seller will either examine the goods at their site, or issue shipping instructions for return to Seller.

When any goods sold hereunder are proved not as warranted, Seller's sole obligation under this warranty shall be to repair or replace the goods, not including installation or any other charges, at its option, without charge to Buyer.

THIS WARRANTY COMPRISES SELLER'S SOLE AND ENTIRE WARRANTY OBLIGATION AND LIABILITY TO BUYER, IT'S CUSTOMERS AND ASSIGNS IN CONNECTION WITH GOODS SOLD HEREUNDER ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS ARE EXPRESSLY EXCLUDED.

CONSEQUENTIAL DAMAGES: In no event shall Seller be liable for consequential or special damages arising out of a delay in or failure of delivery, defects in material or workmanship, or arising out of a breach by Seller of any other term or obligation of Seller under this contract.

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